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MECHANIZATION OF FARM OPERATIONS IN 1965.

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INCREASED MECHANIZATION, MORE EXTENSIVE USE OF CHEMICALS, AND OTHER TECHNOLOGICAL DEVELOPMENTS HAVE REDUCED FARM-LABOR NEEDS AND INCREASED AGRICULTURAL PRODUCTION. COTTON, SUGAR BEETS, POTATOES, AND VEGETABLES FOR PROCESSING ARE SOME OF THE CROPS REQUIRING FEWER MAN-HOURS DUE TO NEW OR IMPROVED TECHNOLOGY. CONTINUOUS EFFORT HAS BEEN MADE TO DESIGN MACHINERY AND LABOR-SAVING TECHNIQUES FOR PRODUCING AND HARVESTING MOST FRUITS, VEGETABLES FOR FRESH MARKET, AND SOME VEGETABLES FOR PROCESSING. MECHANICAL HARVESTING OF MANY CROPS HAS BEEN RETARDED BECAUSE OF LACK OF UNIFORMITY IN SIZE, MATURITY, AND TEXTURE OF THE PLANT OR MARKETABLE PRODUCT. RECENT DEVELOPMENTS AND FUTURE IMPLICATIONS OF MECHANIZATION AND OTHER TECHNOLOGICAL CHANGES FOR 27 SELECTED CROPS INCLUDING APPLES, ASPARAGUS, SNAP BEANS, POTATOES, BERRIES, SUGAR BEETS, TOBACCO, AND TOMATOES ARE DISCUSSED. CONCLUSIONS ARE -- (1) THE MACHINE METHOD IS STILL IN THE EXPERIMENTAL STAGE AND HAS NOT HAD A SIGNIFICANT EFFECT ON EMPLOYMENT IN SOME INSTANCES, BUT IN OTHERS THE USE OF HAND LABOR HAS ALMOST DISAPPEARED, (2) IT IS DIFFICULT TO PINPOINT THE EXACT CROPS TO BE MOST AFFECTED BY MECHANIZATION, BUT AGRICULTURE'S NEED FOR HAND LABOR WILL DIMINISH, AND (3) THE PROCESS OF ADAPTING HAND LABORERS TO A NEW TECHNOLOGY WILL PRESENT PROBLEMS. THIS DOCUMENT APPEARED IN "FARM LABOR DEVELOPMENTS," OCTOBER 1966. (WB)

MECHANIZATION OF FARM OPERATIONS IN 1965

Grover H. Sanders

With increasing mechanization and other technological changes affecting farm-labor needs, the rate of increase of productivity in agriculture is one of the greatest in the national economy. According to the Bureau of Labor Statistics, the index of labor productivity (1957-59=100) was 148.8 for agriculture, but only 122.4 for the nonagricultural sector of the private economy in 1965. Agricultural production had increased 15.0 percent over the 1957-59 level, a smaller increase than that reported for many other industries, but the number of man-hours had decreased 22.7 percent since the 1957-59 period. No other major industry group except mining reported a decrease in man-hours.

Cotton, sugar beets, potatoes, and vegetables for processing are some of the crops requiring fewer man-hours each year because of new or improved technology. Many vegetables produced for canning or freezing, including peas, sweet corn, snap beans, spinach, and lima beans were harvested almost entirely by machine in 1965. Continuous effort is being made to design machinery and labor-saving techniques for producing those vegetables and fruits which are presently unaffected by technological developments or affected only to a small degree. This would include most fruits, vegetables for the fresh market which are picked or cut, and some vegetables for processing. In the last two years, a large proportion of the tomato crop for processing in California has been harvested by machine. In this crop, as well as some other vegetables and fruits, mechanical harvesting has been retarded because of the lack of uniformity in size, maturity, and texture of the item for harvest. Consequently, it has been necessary to develop new plant varieties suitable for machine harvesting.

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Source: Farm Labor Developments, October 1966.

The application of new labor-reducing technology for harvesting fruits has been at a much slower rate than for vegetables. Most fruits are delicate in texture and will deteriorate rapidly if bruised. In addition, trees are awkward structures presenting difficult problems for the designers of harvesting equipment. In spite of these problems, engineers are continuing to improve fruit-harvesting equipment which primarily consists of shaking devices and catching frames. Experimenters have also tried to release fruit from the trees by air blast, sonic waves, flails, and augers. None of these methods has been practicable for picking fruit for the fresh market, but considerable progress has been made in developing mechanical harvesters of some varieties of fruit for processing.

Financial as well as technical considerations contribute to growers' decisions in regard to switching to mechanical methods. Pennsylvania State University researchers have developed the following rule-of-thumb to help growers decide when to mechanize: It's a good investment if costs are no more than 5 times the cost of labor saved in a year. According to the U.S. Department of Agriculture, higher wage rates have contributed to the trend toward mechanization. From 1960 to 1965, wholesale and retail prices of farm machinery and motor vehicles increased at an annual rate of about 2 percent, while the average annual increase in farm-wage rates was about 4 percent. Prospective higher wages will undoubtedly further encourage the substitution of mechanical equipment for hand labor.

The Annual Farm Labor Reports of the State employment-service agencies indicate that the trend toward increasing mechanization, more extensive use of chemicals, and other technological developments continued in 1965, especially in crop activities that have traditionally required a sizable quantity of hand labor. The following summary of recent developments and future implications of mechanization and other technological changes in selected crop activities is based primarily on these reports supplemented by data from other sources.

APPLES

A machine developed at Cornell University went into commercial production in 1966, and four of them were to be used in picking apples for processing in New York groves this year. If they perform successfully on a commercial basis, a considerable amount of mechanical harvesting of processing apples can be expected in a few years.

The harvesting unit consists of two self-propelled catching frames, each 27 feet long and 15 feet wide, and a tree shaker. The apples filter through deceleration strips cushioned with plastic foam as they fall on conveyor belts, minimizing bruises. The belts then carry the apples to bulk boxes. Each harvester unit employs a maximum of 4 men to harvest 150 - 200 bushels per hour, replacing 15 or more handpickers.

Four other States reported developments in apple cultivation and harvesting. Maryland: Chemicals were used by a majority of apple growers for thinning apple crops for the first time in 1965. The method was very successful and it is expected that all apple growers will use this method eventually. Michigan: An attempt is being made to adapt the mechanical cherry-tree shaker and catching device to apple harvesting. Oregon: Increased use of bins in the harvest of apples has tended to reduce the number of workers needed, especially swampers. 1/ A bin usually holds between 22 and 24 standard 44-pound field lugs. One operator, driving a tractor equipped with a fork lift, can handle far more fruit in the orchard than several swampers could previously handle with standard field lugs. Virginia: One experiment involves planting and training apple trees to form a "wall" 5 to 6 feet thick and 10 to 14 feet high. The idea is that men riding at two levels on a low trailer moving slowly down the tree row can reach the center of the trees. They can pick either onto a conveyor or into conventional picking bags. With such a system, a picker can harvest significantly more fruit in a given time than with present methods.

1/ A swamper in the apple harvest is a laborer who lifts, loads, unloads, and dumps apples.

ASPARAGUS

Washington: A machine designed to harvest a 40-acre asparagus field on a once-over-daily basis is in the testing stage. Both a single-row and a two-row harvester are being developed to handle green asparagus as gently as a human hand. One machine was to be field tested in 1966. The cutting units are attached to an adjustable frame which can be set at heights ranging from 4 to 8 inches above the ground. Thus the asparagus can be cut at the desired height, while the shorter stalks are passed over. When the machine reaches an asparagus stalk of the desired height, tubular rubber belts grasp it, an electronic trip activates the cutting knife, and the spear is severed at ground level or slightly below and transported to a conveyor belt that deposits it in a side box. The one-row model tested has 15 tubular gathering units each covering a 2-inch space. The two-row unit contemplated will have 30 such units. Electric power to activate the sensing and cutting devices in the prototype was supplied by storage batteries, but in a commercial unit, the power will be furnished by the machine's electrical system.

Yakima Morning Herald photo

This battery-operated harvesting machine cuts the asparagus spears at the desired length and deposits them in the boxes at the side.

These machines are the most promising tried so far. There are, however, many "bugs" that must be corrected. Some growers estimate that mechanization of the asparagus harvest is at least 5 years away. California, Delaware, Michigan, and New Jersey also reported that research and experimentation continued in the search for a practicable mechanical harvester.

SNAP BEANS

Eighteen bean-harvest machines were used in the Belle Glade area of Florida in the fall of 1965. Machine capacity was estimated at 3½ - 5 acres per day, and each machine replaced 50 to 80 workers per day. The machines were generally used after the beans had been picked once by hand. Snap-bean pickers in Tennessee displace approximately 100 workers each. The effect of these labor savings on employment was offset by increases in acreage and yield. About half of the snap-bean crop was harvested mechanically in 1965. Less than 7 percent of the planned 1966 Kentucky acreage was to be harvested by hand in 1966, compared with 100 percent two years ago.

Virtually the entire processing crop in New York and New Jersey is harvested mechanically. The shift to mechanical picking for the second harvest in Maryland increased in 1965, especially in the north central part of the State. About 95 percent of the Delaware crop was harvested mechanically in 1965. The development of more efficient machines may reduce costs, but there would probably be little effect on labor requirements.

In Oregon, the Willamette Valley acreage in bush beans (for mechanical harvest) rose by about 1,500 acres from 1964 to 1965. Pole-bean acreage (for hand harvest) is expected to decline at a relatively low rate for several years. Idaho growers are experimenting with replacing pole beans with bush beans.

BERRIES

Michigan: A blueberry-harvesting aid consisting of a hand-held vibrator and catching frame has been used for several years, primarily to relieve labor shortages late in the season. In 1965, however, because of the availability of more efficient sorting equipment, many growers used the shakers for the first picking.

A more recent development, which could revolutionize the blueberry harvest, is a harvester which reportedly can harvest one-half acre per hour and cut picking costs to less than one cent per pound. This machine is self-propelled and straddles the row of berries. As it moves down the row, vibrating fingers mounted on two revolving drums shake off up to 90 percent of the ripe fruit. Experiments with a prototype machine in 1965 demonstrated the feasibility of this type of harvesting, and the manufacturer expects to market the machines for the 1967 season.

A mechanical strawberry harvester, being developed by Michigan State University, was field tested recently. The picking machine uses a rotary continuous rake which lifts the berries onto a canvass without bruising. The machine must work from a level field. It has application for harvesting marigold seeds, cranberries, and other types of low bush crops.

Interest is also being shown in a mechanical raspberry harvester which seems to work well only on heavy soils. The machine was successfully tested in Arkansas, but on the lighter soils of Texas it was a failure. Experiments will be conducted in Michigan in 1966. In the Alpena Area, where the strawberry harvest is the principal labor-using activity, one grower constructed a three-man personnel carrier and was very well satisfied with the results. He estimated that picking production was increased by 50 percent through use of his device.

BRUSSELS SPROUTS

California: About 850 acres were harvested by machine in 1965. Production averaged 4 tons per acre, as compared with 5 to 7 tons per acre for hand-harvested sprouts. Some damage was reported, but harvest time was cut by two-thirds. New York: Harvesters are in the development and trial stages. There is no doubt they will be used extensively in future years.

CABBAGE

Michigan: Research is continuing in the development of a harvester for this crop. New York: A cabbage harvester is in the development or trial stage. North Carolina: Agricultural engineers at North Carolina State College have done considerable work on developing a mechanical cabbage harvester which consists of a hydraulically driven band-saw blade to lop off the head an inch or two above ground level. A conveyor system moves the cut heads from the band-saw blade to a separator which eliminates undesirable outer leaves. At last report, the equipment could move at about $1\frac{1}{2}$ miles per hour.

CARROTS

California: In the Santa Barbara area, the carrot harvest is mechanized, and each machine replaces 30 hand toppers. However, there still must be some handwork in the fields for cleaning up corners, etc. All machine-harvested carrots must be shed sorted, causing need for more shed workers. In the South Coast Area carrot diggers, graders, and washers were used. Carrot harvesters were also used around San Luis Obispo. Minnesota: Carrot-harvesting combines have greatly reduced the need for vegetable workers.

CELERY

Florida: One of the companies which pioneered the development of the "mule-train" celery 1/ harvester has designed and built a complementary unit working at the front of the ordinary harvester that cuts the stalk, aids in stripping, and conveys it to the topping belt. A tempered sharp blade is pushed by the forward movement of the machine at a controllable height above the ground to cut the stalk, as it is gripped by a set of belts. Metal prongs, at a pre-set distance apart and parallel with the ground, pass on each side of the stalk on its angled rise to topping-belt level to strip surplus stems. The machine has cutters in front for ten rows, and travels at the rate of 10 to 12 feet per minute; the "mule-train" normally travels at five to six feet per minute, with 20 cutters (stoop labor) in front. Therefore, the mechanical 10-row cutter travelling at twice the speed of the "mule-train" cuts as many rows per day as the old machine employing 20 hand cutters.

CHERRIES

California: An experimental shaker drops the fruit, without stems, onto a canvas and immediately into a brine solution to prevent spoilage. Difficulties were reported with treebark damage. Idaho: Use of tree shakers in the harvesting of sour cherries is increasing. Michigan: Many improvements have been made on the tree shaking device and catching frame originally developed for the cherry harvest and first used on an experimental basis 10 years ago. The latest machines consist of two self-propelled units, each with half of the catching apron and a shaking boom. Half of the machine is positioned on each side of the tree, and the operators then harvest the fruit by giving several short bursts of shaking to each of the primar limbs. The cherries fall to the apron and are moved by conveyor into steel tanks partially filled with water. The tanks are moved with the harvester on a fork lift and, when full, are removed from the orchard to a waiting truck. Average harvest time with this type of operation is about $3\frac{1}{2}$ minutes per tree. Under ideal conditions fruit can be removed at the rate of 90 seconds per tree. In 1965, approximately 80 machines were used to harvest about 10 percent of the cherry crop, compared with 50 machines which harvested 5 percent of the crop in 1964. A comparable increase was expected in 1966. According to growers using the machine in the Manistee Area, the cost of the harvest runs from $\frac{1}{2}¢$ to 1¢ per pound compared with $2\frac{1}{2}¢$ to 3¢ for hand-picked fruit. The predominant problem in the Traverse City Area was the reluctance of processors to accept the mechanically harvested fruit, as most plants are not set up to handle this type of harvest in volume. New York: The cherry shaker, when first used, broke tree branches, bruised fruit, and was bulky and difficult to maneuver. However, each year more shakers are in operation.

1/ For a description of the "mule-train" see Farm Labor Developments, April 1966 page 14.

CORN (FIELD)

Corn-detasseling needs have been reduced significantly in the last few years and will continue to decline in Illinois and Minnesota as sterile hybrid seed corn, which requires no detasseling, is used more extensively. Illinois now employs only 10,000 detasselers compared with 25,000 a few years ago. Minnesota reported that the 2,000 seasonal workers used at the peak of the corn-detasseling season in 1965 was less than half the 1959 peak. Another important development is the picker-sheller. In Iowa, increasing use of picker-shellers and drying equipment has lessened the need and opportunity for corn gleaning. The high cost of this equipment makes it unreasonable for each farmer to own the equipment and has resulted in increased custom harvesting. Thus, many farmers have sold their pickers and elevators in favor of custom harvesting and drying. This has resulted in less demand for harvest labor. The picker-sheller has also become popular in many areas of Kansas.

CORN (SWEET)

California: A picking machine for fresh-market corn was used for the first time in 1965. Using 2 operators, it replaces 4 handpickers. Delaware, Idaho, Illinois, Iowa, Kansas, Minnesota, North Carolina: Sweet corn harvesting for processing is entirely mechanized in these States. In addition, Idaho sweet corn raised for seed is also harvested mechanically.

COTTON

About 85 percent of the 1965 U.S. cotton crop was picked by machine. The degree of mechanization increases, generally, from east to west; from 65 percent in North Carolina , to 90 percent in Texas, to 98 percent in California. (See Table 1.) Although the proportion mechanically harvested rose significantly in several States from 1964 to 1965, cutting peak labor needs and the length of the picking season, the greatest source of new labor savings seems to be chemical weed killers. A 28 percent acreage reduction in 1966 has reenforced the effect of labor-saving devices in diminishing labor needs this year. Even though technological improvements have greatly reduced the need for hand labor, however, they have by no means eliminated this need. The physical character of some fields sets practical limits to machine harvesting, and heavy rains can render chemicals and machines ineffectual.

Over the last two decades (1945-65), cotton production has increased by two-thirds despite decreases of one-fifth in acreage harvested and more than two-thirds in man-hours of labor used (See Table 2). The index of production per man-hour increased fivefold.

Table 1.

Percent of Cotton Harvest Mechanized, by State, 1960, 1964, 1965

State	Percent of harvest mechanized		
	1960	1964	1965
United States	51	78	85
Alabama	8	55	73
Arizona	73	97	98
Arkansas	42	75	83
California	87	97	98
Florida	10	72	76
Georgia	14	62	78
Louisiana	49	78	82
Mississippi	40	68	76
Missouri	56	83	90
New Mexico	64	85	92
North Carolina	12	59	65
Oklahoma	64	83	84
South Carolina	6	63	73
Tennessee	19	56	70
Texas	58	85	90
Virginia	1	26	41

Source: U.S. Department of Agriculture.

Table 2.

Cotton Production, Labor Requirements, and Mechanization, 1945-65

Year	Acres harvested (Thous.)	Bales produced (Thous.)	Man-hours of labor (Million)	Index number of production per man-hour (1957-59=100)	Percent of harvest mechanized
1945	17,029	9,015	1,583	39	INA
1950	17,843	10,014	1,298	53	8
1955	16,928	14,721	1,235	81	23
1960	15,309	14,272	831	116	51
1965	13,617	14,956	503 1/	203 1/	85

INA = Information not available.
1/ Preliminary.
Source: U.S. Department of Agriculture.

Southeast

Cotton-harvest mechanization is least advanced in the southeastern States. Only in Georgia was more than three-quarters of the crop picked by machine in 1965. Labor needs in this region although lower than previously, remained heavy at the 1965 peak; but mechanization shortened the harvest season in some areas by as much as four weeks. Local scheduling of mechanical pickers in Georgia increased the amount of custom harvesting; machines moved from south to north as the harvest was completed. The rough terrain and small fields that are typical of North Carolina limit mechanization possibilities in that State.

The successful use of chemical weed killers - about 60 percent of the crop was sprayed in Alabama - cut preharvest labor requirements significantly. A clean crop is essential to get good grades at the gin after mechanical harvesting.

South Central

About four-fifths of the 1965 crop was machine picked in Mississippi, Louisiana and Arkansas, but only seven-tenths in Tennessee. The degree of mechanization is expected to increase somewhat in Tennessee, but further advances in the other States are unlikely because of terrain and the possibility of prolonged rains. The reduction due to mechanization is perhaps more evident in duration of labor use than in peak needs. Mechanical harvesters shortened the harvest season by one week in Mississippi and by three weeks in Tennessee from 1964 to 1965.

Four-row cultivators, flame cultivators, and especially chemical weed killers have cut preharvest labor needs significantly. Improvements in chemical weed-control agents are expected to bring further reductions, particularly in the length of the preharvest season. Nearly half of the total Mississippi acreage was treated with trifluralin prior to planting in 1966, compared with slightly over a quarter in 1965. Mississippi farmers planned to treat approximately 60 percent of their acreage with preemergent chemicals and 50 percent with postemergent chemicals, creating a pattern of early and continuous use of chemicals beginning before the planting season and lasting until the harvest season.

Reductions in labor demand are being matched, to some extent, by reductions in supply in Tennessee. Industrialization is spreading across the State, absorbing young and middle-aged men into nonagricultural jobs and leaving the cotton harvest more than ever to women and older men.

Mechanical harvesting in Texas and Oklahoma has now reached such proportions that further steep reductions in farm jobs due to increased mechanization are unlikely.

Southwest

The need for hand weeding in New Mexico has been greatly diminished by chemicals that kill from 50 to 95 percent of all weeds and grasses. Many growers discontinued thinning after the adoption of mechanical pickers that apparently perform more efficiently in thick cotton. Less cotton is dropped when there is a continuous stream entering the suction pipes. The use of mechanical harvesters increased significantly in 1965 after it seemed that a limit had been reached.

The very high proportion of Arizona cotton that can be picked by machines is due largely to the cleaners built into harvesters that make their production more acceptable to the gin. An attachment that was used extensively in 1965 retrieves low bolls and ground cotton. New strains of cotton, such as Deltapine have enhanced picker use and allowed machine picking to start sooner.

CUCUMBERS (PICKLES)

Indiana: A multi-harvest cucumber machine was used in the field during the 1965 season. Though not perfect, the harvester performed well on the variety of cucumber now grown. This type of machine may be the answer to cucumber picking if the "one time harvest," now in the experimental stage, does not come up to expectations. Michigan: Demonstrations of a once-over pickle harvester were conducted in the Muskegon and Saginaw Areas in 1965, and many of the pickle processors in attendance expressed satisfaction with the performance of the machine. In theory, the machine is quite simple. It picks up the vines by the tops and conveys them to a wringer-type device. The vines being smaller, are pulled through; the bigger and harder pickles are pinched off. The pickles are conveyed past a man riding the machine who sorts out culls and trash; then they go into a hopper which is unloaded, when full, by another conveyor. There were reports that as many as 30 of these machines would be used in Michigan in 1966, and that they would harvest up to one-third of the total acreage. The major obstacle to complete mechanization of the pickle harvest now appears to be the development of a high-yield pickle with a high initial set of fruit. Michigan State University is doing considerable research in this area. Seven hundred (700) pounds of seed from three varieties showing particular promise were to be planted in Michigan in the spring of 1966. Yield per acre was expected to be between 175 - 200 bushels, considerably less than on hand-harvested acreage. Even with the low yield, growers expect to be able to show a profit because of the reduced labor cost for harvesting. A few personnel carriers were used in the 1965 harvest, but it is questionable whether worker productivity was increased.

DATES

California: A few growers in the East Riverside area are building hydraulic equipment, either the crane or lift type, for elevating workers into date palms to perform both harvest and nonharvest tasks. This equipment is safer and more efficient than ladders which have been used for the 20-to-60- feet high trees.

GRAPES

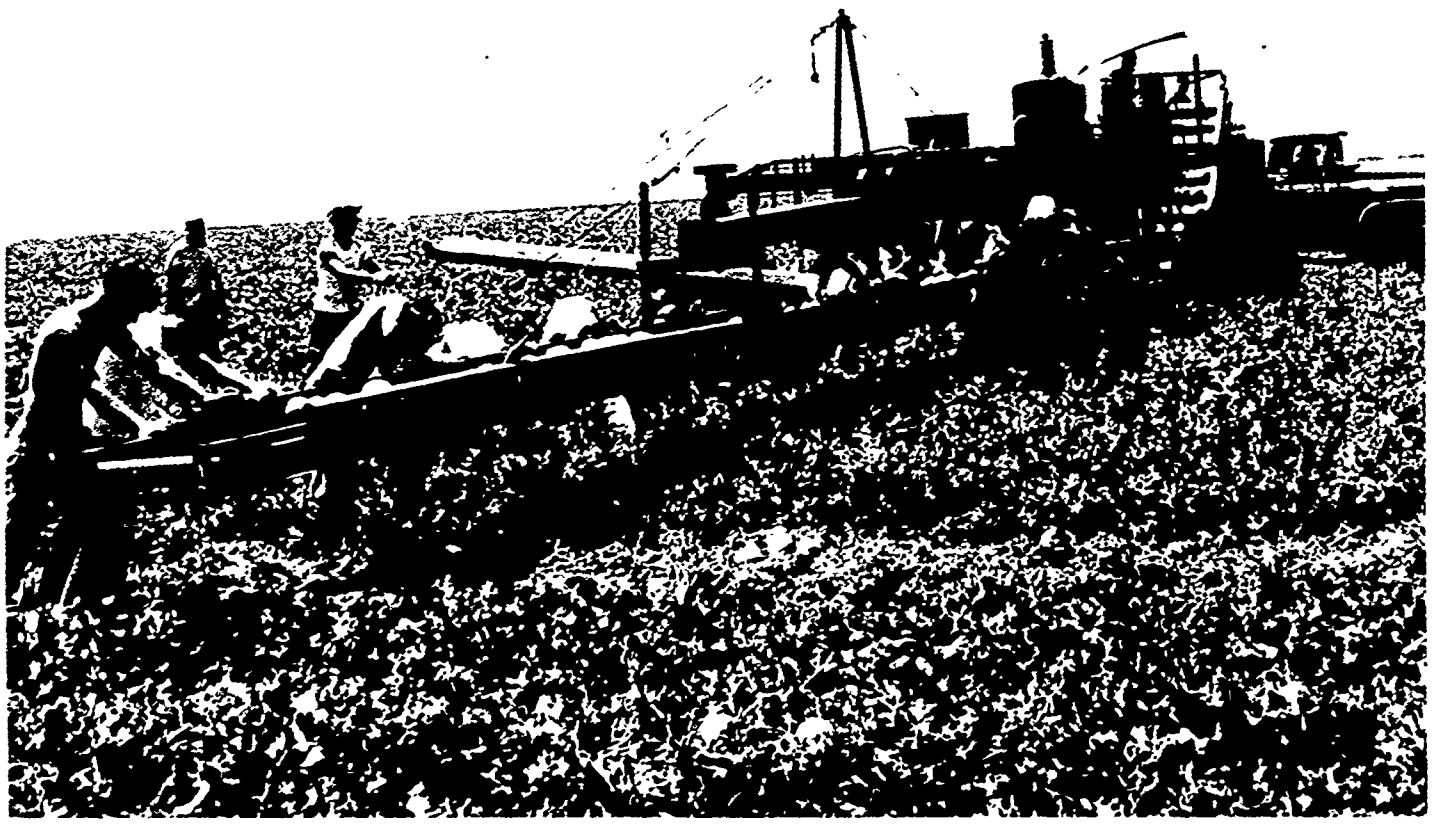
California: A large number of San Bernardino grape growers installed a tractor-mounted conveyor belt system. This made it easier for the pickers and speeded up picking. One grower used a 90-foot boom conveyor belt system, which could be raised or lowered hydraulically. This provided for picking of 9 to 10 vineyard rows at a time. New York: A mechanical grape harvester successfully harvested 80 acres of grapes in 1965. However, there will be a few years of transition while growers make trellising changes in the vineyards to accommodate the machine.

LETTUCE

California: Two harvesters have been developed but not sold. A unit which was researched by the University of California has been made into a full-scale commercial harvester. A University of Arizona experimental harvester is in an uncertain stage of development. Lettuce harvesters are not likely to be used to their fullest extent until labor becomes scarce and cultural practices are improved to the point where most of the heads ripen at the same time. Also, current field-packing practices would have to be changed radically to keep up with the speed of the machine or else more packing would have to be done in the shed.

MELONS

California: In 1965, a loading device was developed which transports melons from the ground to the conveyor belt, reducing the size of the work crew by one-third. This device can be adapted to most conveyor belts. Workers who were unwilling to pick melons when the job involved carrying 80-pound sacks have become available to growers who have machines to do the heavy lifting. An equipment-manufacturing firm has been testing an improved unit in the Imperial and Blythe areas. The company hopes this unit will replace the melon pickup crew. The machine spans 8 beds and has a paddle-wheel-type gathering unit on the ground end on each of the 4 conveyor belts. Handpicked melons are windrowed in every second furrow and then picked up by the machine and loaded. Texas: Until 1965, the melon harvest in the Laredo area had never been accomplished without Mexican nationals. By providing a conveyor system in the field it was possible to utilize women and school youth, and the entire crop was harvested without difficulty.



High-school students in a melon-picking crew organized by the manager of a California Department of Employment Farm Labor Office and a representative of the farmer that hired them. They worked behind the rig shown, picking the melons and placing them on a conveyor belt which carried them to the elevated leader and into the truck for haul-out. The rig moved at a speed of about 3 or 4 miles per hour.

OLIVES

California: Sixty to 80 percent of Mission and Sevillano olives responded to experimental machine shaking, but Manzanillos were difficult to shake from the tree by this method. The possibilities of using a chemical loosening agent were explored in 1965.

ONIONS

Arizona: Green onions are at least several years away from any degree of mechanization that will significantly reduce the number of workers required. California: In the Salinas Valley, a new green-onion puller with a crew of 12 did the work of 30 hand laborers in 1965. For dry onions, grading machines were used and some growers experimented with an onion-topping machine. Minnesota: Mechanical loaders for picking up windrowed onions have eliminated sacking and sack loading in the fields. Experiments with mechanical onion toppers have proven reasonably successful in some areas and may eventually eliminate the need for workers to hand-top dry onions. New York: Onion growers no longer worry about harvesting before youth go back to school. Machines harvest a greater percentage of the crop each year. Nevada: Continued improvement in cultivation practices and use of sprays significantly reduced hand labor in the garlic-onion crop in 1965.

PEANUTS

Alabama: Approximately 90 percent of the 198,000 acres of peanuts in the State was mechanically harvested in 1965. The crop was picked green and artificially dried. A large percentage of the crop was postmerged with chemicals to kill grass and weeds, and more growers used combines for the harvest than in 1964. North Carolina: The harvest of peanuts was 90 percent mechanized in 1965, and no further mechanization was expected. One criticism of the combine is that it shortens the harvest season and overloads storage facilities.

GREEN PEAS

Idaho: The harvest of green peas is continuing to be mechanized through the use of combines which eliminate stationary viners. In the Lewiston area, the addition of five self-propelled viners and two automatic feeders for the stationary viners reduced manpower needs by about 90 workers per day in 1965. More self-propelled viners were expected to be used for the 1966 harvest. Illinois: The high cost of the green-pea-harvesting machine confines its use to the large operations--the multi-state canners. Harvest times are staggered where possible to allow these machines to be transferred between plants. Maryland: Machines were used extensively in 1965 for the harvest of green peas.

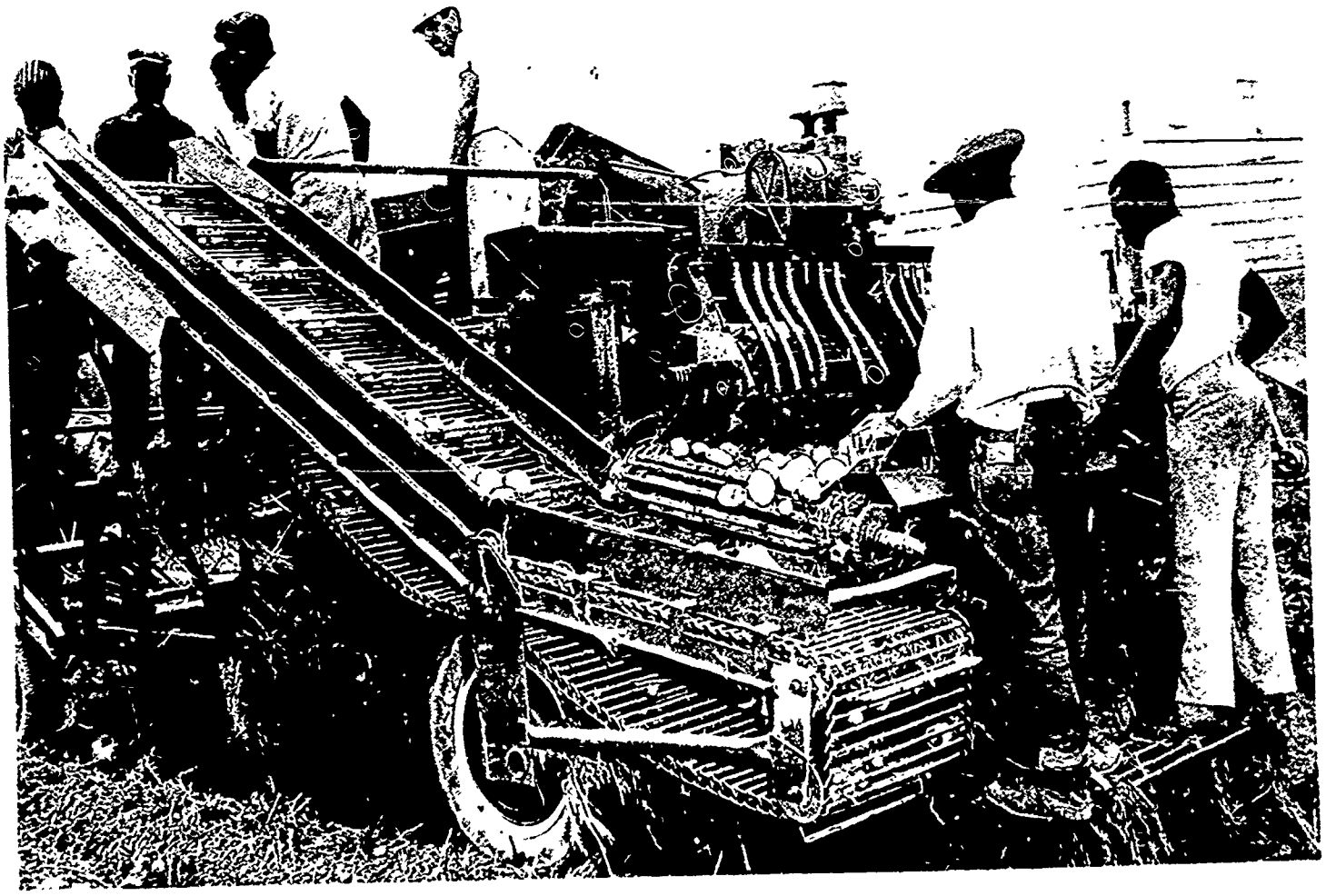
Minnesota: Mechanization of the green-pea harvest is the main factor in a steady reduction of seasonal farm labor. The number of mobile combines is expected to increase each year and will eventually replace all the stationery viner units. Mechanization has permitted bulk handling, eliminated the stacking of vines, and created a demand for truck drivers and machinery operators. New Jersey: Green peas are nearly all harvested by machines. Oregon: The green-pea harvest was becoming more highly mechanized as more combines were being used in 1965. Combines can be operated by one man and some are self-propelled. Eventually, most stationary-viner units are expected to be replaced by combines, thereby further reducing the number of seasonal workers needed in the pea harvest.

Washington: In 1965, more extensive use was made of the mobile viner. By comparison, eight men operating five mobile viners were almost as productive as 29 workers operating a 12-unit stationary viner set.

POTATOES

About 90 to 95 percent of the Idaho potato harvest was mechanized in 1965 but some hand laborers were required to sort out clods and trash as the harvester loaded the potatoes into trucks. Only one or two sorters are needed per machine, compared with up to six a few years ago. Mechanical seed cutters and planters which cut the seed as it is planted are being developed to make volume cutting possible. Seeds may be lost through rot if not planted soon after cutting.

A six-man bulk loader used in California replaces approximately 40 hand-workers. In Oregon, also, potato-bulking machines reduce the number of sorters needed and shorten the harvest. Two-and four-row specific gravity mechanical harvesters are being used successfully by the larger Colorado growers.



With this mechanical potato picker, a crew of 12 men can do the work previously requiring 33 persons.

About 95 percent of the 1965 Minnesota crop was harvested by combine, making necessary only a small force of handpickers to cover fields too small or soggy for the combines. In Michigan, bulk handling, herbicides, electronic sizers, and mechanical harvesters are becoming more widespread each year.

The mechanical harvester, once thought to be unadaptable to the upland farms of New York, is now beginning to be used on these farms. About 80 percent of the New Jersey crop is harvested by machine.

The number of combines in operation in Maine has gone from 274 in 1964 to 450 in 1965 to an estimated 600 in 1966. The number of handpickers needed declined by about 1,750 in 1965 and a further reduction of over 1,600 was predicted for 1966. The single-row machine, which digs 600-700 barrels per day, displaces at least 10 pickers; and the double-row combine, which digs 1,200-1,500 barrels per day, replaces 22 to 25 pickers.

SPINACH

Arkansas: Machine harvesting of spinach has steadily increased, but many small growers cannot afford the expense of buying a machine and must still rely on hand labor. New Jersey: Spinach is almost completely harvested by machine. Oklahoma: Successful machine harvesting of spinach has occurred in recent years.

SUGAR BEETS

The use of cultivation-labor savers such as pelleted monogerm seed, precision planters, flextine harrows, mechanical thinners and blockers, and chemical weed killers has cut hand-labor requirements sharply for preharvest work in almost all of the sugar-beet States. In Minnesota, for example, workers were recruited on the basis of one for 25 acres. Fifteen years ago one worker could cover only 9 acres. Complete mechanization of preharvest work in the near future is predicted in Colorado; but predictions in other States are more cautious, citing the importance of favorable weather and soil condition. In Nebraska, preharvest mechanization is said to have made little progress in the past several years. The sugar-beet harvest is almost completely mechanized in most States.

SUGARCANE

Florida: One of the major sugar companies experimented with a harvesting machine in the fall of 1965. The unit did not prove to be practical enough to rely on for steady production. However, with the aid of the U.S. Department of Agriculture, continuous changes in design are taking place. Mucky soils and recumbent cane were among the problems encountered with the 40,000-pound Louisiana cutting machine which experimenters used in the Belle Glade area. Also, the machine tore up cane stubble, preventing further growth. Unlike Louisiana, the Belle Glade soil is loose, has poor root-holding ability, and limited traction qualities. The cane is frequently blown over by harvest time. Although these factors have aborted efforts to mechanize cutting, postcutting activity is already mechanized. Continuous loading machines pick up the cane and dump it into waiting carts for transportation to processing mills. Louisiana: Three newly introduced sugarcane-planting machines were put into commercial use at the beginning of the 1965 planting season. However, Hurricane Betsy occurred just as planting got underway, and the adverse conditions created by the storm forced abandonment of the machines for the season. Prospects were that these machines would be used again in 1966 with further improvements and refinements. Thus a decrease in future seasonal labor needs for cane planting is predicted. Sugarcane-harvesting machines are already heavily used in the State.

TOBACCO

Kentucky: Experiments are being conducted to develop an automatic curing process for burley tobacco. Although the process is thought to be some years away from practical application, it could revolutionize the burley industry. In the experiments, primed leaves are cured in a matter of minutes, after which they are ready for marketing. If fully developed, this process would eliminate the need for large curing barns and would reduce the time of harvesting and marketing burley tobacco by one to three months. North Carolina: Mechanization has been slow for flue-cured tobacco which is used primarily for cigarettes. Mechanical primers have been operated on an experimental basis in harvesting, but no widespread use is anticipated for the next few years. There has been some increase in the use of mechanical loopers, but this has not significantly reduced the demand for barn hands. Looping is the process whereby the tobacco leaves are prepared for hanging between tier poles in the curing barn by stringing them onto sticks about $4\frac{1}{2}$ feet long. Bulk curing of tobacco which is a companion to mechanical priming has passed the experimental stage, and more growers are having these curers installed each year and using them along with hand labor. The bulk curer eliminates the use of barn hands in the harvesting process.

TOMATOES

California: Substantial progress was made in mechanizing the tomato harvest in 1965. Little more than a promising experiment in 1964 when 3 to 3½ percent of the canning-tomato crop was harvested mechanically, some 262 machines harvested approximately one-third of the 2½-million-ton 1965 crop. Growers were steadily ordering the new harvesters, and it was estimated that some 800 of these machines would harvest the bulk of the 1966 crop. Each machine requires 16 to 22 hand sorters and can harvest from 7 to 10 tons per hour. One worker on the machine is equivalent to almost two good handworkers. In just two years the tomato harvester has moved from experimental status to large-scale utilization. Colorado: One Arkansas Valley grower ordered six mechanical harvesters for his 1966 tomato harvest. The machines, which are comparable to those used in California, require the planting of a new variety of tomato which will produce a complete yield for one-time harvesting and will not bruise easily. Illinois: The first tomato-picking machines introduced in 1962 proved of doubtful value and were discontinued. However, experiments are continuing in an effort to develop a suitable machine. Iowa: No mechanical picking of tomatoes is expected for a few more years. Michigan: Machine harvesting has been successful for the small Roma variety of tomatoes. Acreage for this variety of tomato is so small that the change in demand for labor has been negligible. New York: Tomato harvesters are in the development and trial stages. Ohio: There are problems still to be solved before the tomato harvester is widely accepted in this State. Experiments are continuing in an effort to build a machine suitable to the climate and soil conditions. Also, a new tomato variety is needed to ripen nearly all its fruit at the same time and hold its quality on the vine. In addition, varieties are needed to mature at different periods through the season. These are necessary for economically timed deliveries to processors. Dirt and sod have caused problems for the machines, and the dirt mixed with the harvested tomatoes causes contamination from micro-organisms in the soil. Wet weather is also a problem. Machines used in California do not face these hazards.

CONCLUSION

State employment security agencies, in their 1965 post-season farm labor reports, have mentioned 27 crops which are subject to varying degrees of mechanical handling. In some instances, the machine method is still in the experimental stage and has not had a significant effect on employment. In other crops, workers are being displaced each year as machines take over the hand operations. Machines have already invaded the production of some crops to such an extent that the use of hand labor has almost disappeared.

The experience of 1965 is a precursor to what may be expected in the years to come. It is difficult to pinpoint the exact crops which will be most affected by mechanization, but it is possible to foresee that agriculture's need for hand labor will diminish. The process of adapting hand laborers to a new technology presents problems. However, the long-run effect of mechanization should prove beneficial. The grower will be able to produce his crop more efficiently and can provide more